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HISTOLOGY OF FLAX FRUIT

KATE BARBER WINTON

(WITH FOUR FIGURES)

Flax (*Linum usitatissimum* L.), although grown throughout the temperate zone for its fiber, is valuable as well for its seed, which yields the well known linseed oil, the residue being used as a cattle food. The chaff from the threshing of the seeds, consisting of broken pods and stems with varying amounts of immature and broken seeds, has of late come into the cattle food market under the name "flax bran."

The histology of the fiber is described by VON HÖHNEL,¹ HANAUSEK,² and other technical microscopists, and that of the seed by writers on the microscopy of foods and drugs,³ but the elements of the pericarp appear to have escaped attention except for brief mention by COLLIN and PERROT,⁴ with whom the present writer does not entirely agree.



FIG. 1.—Dehiscing fruit with sepals; $\times 2$.

The yellowish pods (fig. 1), 8 mm. in length, are slightly broader than long, with five pointed sepals and a slender pedicel. Each of the five locules is incompletely halved by a false dissepiment, making a 10-celled fruit which dehisces at maturity into ten valves. Each cell contains a single flattened, shining, brown, mucilaginous seed.

CALYX.—The *outer epidermis* consists of longitudinally elongated cells with wavy walls and simple stomata. The cuticle has faint longitudinal striations.

Mesophyll.—Several layers of simple parenchyma cells, through which runs a network of small bundles, form the mesophyll.

The *inner epidermis* is similar to the outer.

¹ Die Mikroskopie der Technisch Verwendeten Faserstoffe. Wien, 2 Aufl. 1905. p. 42.

² Microscopy of technical products. Trans. by WINTON. New York. 1907.

³ See bibliography in WINTON, Microscopy of vegetable foods. New York. 1906. p. 204.

⁴ Les résidues industriels. Paris. 1904. p. 202.

PEDICEL.—The *epidermis* is made up of longitudinally elongated rectangular cells with straight, pitted walls. Occasional simple stomata are present.

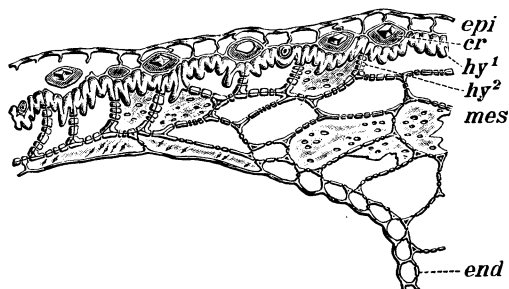


FIG. 2.—Pericarp in cross-section: *epi*, epicarp; *cr*, crystal cells; *hy¹*, projections of hypoderm; *hy²*, hypoderm; *mes*, mesocarp; *end*, endocarp; $\times 160$.

Subepidermis.—A few layers of small thin-walled parenchyma form this tissue.

Bast.—The conspicuous elements constituting the bulk of the pedicel are the bast fibers. They are greatly elongated thick-walled cells

with occasional characteristic cross-striations resembling joints, and conform in general structure to the bast fibers of the stem, which yield the linen of commerce.

The *xylem* contains spiral and pitted vessels, wood fibers, and parenchyma cells without distinctive features.

None of the tissues of the calyx and pedicel is of especial diagnostic importance.

PERICARP (figs. 2 and 3).—The *epicarp* (*epi*) consists of a single layer of collapsed cells whose outlines are

found most easily in surface view. They are frequently longitudinally elongated to about twice their width, have straight thin walls, and occasionally yellowish contents which harden at maturity, retaining the shape of the confining cell walls. COLLIN and

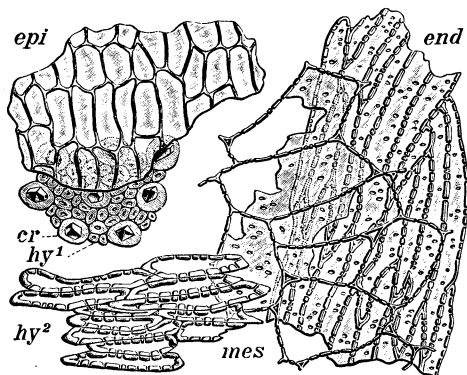


FIG. 3.—Elements of pericarp in surface view: *epi*, epicarp; *cr*, crystal cells; *hy¹*, projections of hypoderm; *hy²*, hypoderm; *mes*, mesocarp; *end*, endocarp; $\times 160$.

PERROT (*loc. cit.*) describe crystals in this layer, but the writer finds them in an interesting tissue below the epicarp.

Crystal cells (cr).—Resting on the hypoderm and more or less separated by its projections is a strikingly characteristic tissue one cell in thickness, consisting of isolated compressed spherical or lens-shaped cells arranged in indistinctly longitudinal rows. The light brown inner and side cell walls are so thickened that the cell contents, consisting of a single monoclinic crystal (about $13\ \mu$), completely fill the lumen. On sectioning, the crystal usually escapes through the thin outer wall.

The *hypoderm* (*hy*¹ and *hy*²) is yellowish in color, pitted, and greatly thickened, with numerous projections of the outer wall pushing up under and between the isolated crystal cells. In tangential sections through the outer walls these projections (fig. 3, *hy*¹) appear like another layer of small, more or less spherical cells. The cells are transversely elongated over the greater part of the valve, changing abruptly to a longitudinal arrangement at the sutures.

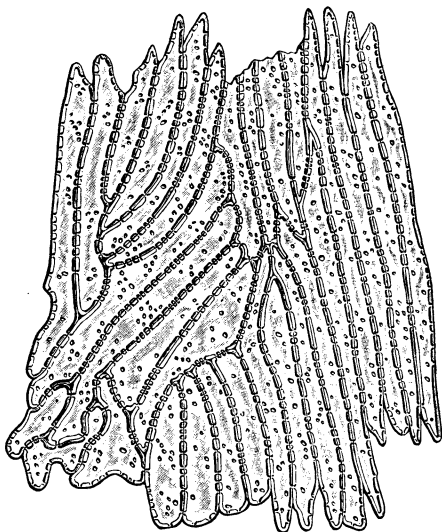


FIG. 4.—Dissepiment in surface view; $\times 160$

The *mesocarp* (*mes*) varies greatly in thickness. At the thin center of the valve it is frequently lacking, but becomes a thick mass of cells along the juncture with the dissepiment. The cells have slightly thickened pitted walls, except those adjoining the hypoderm, which may be thicker. Cell contents are usually lacking though occasionally small starch grains are present indicating slight immaturity.

Endocarp (end).—The single layer of pitted, strongly elongated cells, arranged side by side in groups, is similar to the epidermis of

the dissepiment, with which it forms one continuous tissue, the only noticeable difference being that the cells are somewhat smaller.

DISSEPIMENT (fig. 4).—This transparent papery tissue at once attracts attention, being made up of two parquetry-like epidermal layers of elongated, pitted cells between which is an inconspicuous empty parenchyma. The cells of one epidermis frequently cross those of the other, which at once distinguishes the dissepiment from the endocarp. The walls are approximately straight except at the free edge of the dissepiment, where they become sinuous, acquiring beautiful irregular shapes. The contour of the cell varies greatly with the focus, owing to irregularities of the end walls.

CHARACTERISTIC ELEMENTS.—The tissues which are of chief value in the identification of flax fruit in ground products, such as mixed cattle feed, are the elongated, thick-walled cells of the hypoderm with projections (figs. 2 and 3, *hy*^t), the accompanying cells each containing a single crystal (*cr*), and the transparent dissepiments with elongated cells (fig. 4), those of the two epidermal layers often crossing at an angle.

All of these tissues are quite different from the elements of any other material likely to be encountered.

WASHINGTON, D.C.